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RESEARCH ARTICLE

LIFELONG LEARNING WITH ARTIFICIAL INTELLIGENCE: POTENTIALS, CHALLENGES AND FUTURE PERSPECTIVES

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Manuscript Info

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Abstract

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This research focuses on how artificial intelligence education can enhance lifelong learning, personal adaptation to the learning environment, and intelligent tutoring systems. Key themes and insights were identified by conducting an exploratory review of journal articles and readings of corresponding case studies. The use of AI in education encourages innovations for learning, such as personalized learning, where faculty and instructional designers tailor the instructional content to better suit the learners' needs, participation, and accomplishment. In addition, varying learning environments that change about the current moment depending on the student performance are also characterized by increased learning effectiveness. The resulting feedback is tailored to the learner's needs and improves the learning experience.However, integrating artificial intelligence in course systems raises ethical and privacy concerns, which correspond to the need for strict rules for handling data and their use. Also, it is crucial to point out that interventions have the potency to overpower such negative effects, and here, the digital divide is a significant hurdle in propagating AI. This study provides specific recommendations to educators/institutions, particularly concerning improvements of AI in lifelong learning, and also presents policies to nurture such an application. The long-term influence of AI on the education system must be analysed from an ethical perspective in the future.These results demonstrate the capability of AI to revolutionize the learning process for all society; therefore, they help to understand the barriers that existed during popularization for the development of AI into a tool to benefit all of society.

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Introduction:

Considering current education trends, embracing life-long learning as an indispensable prerequisite for human and social development is imperative. Thus, while traditional education is generally associated with formal education and completing years of schooling and college, lifelong learning does not see people in age or occupation and acknowledges that everyone wants to develop their knowledge and skills throughout their lives (Drewery et al., 2020). AI remains an innovative invention that contributes to change in modern education, thus developing a

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solution that can revolutionize study processes and outcomes (Shah, 2023). Consequently, the adoption of AI in processing and analyzing large volumes of information, possibly by considering the individual learning experiences and real-time formative feedback in education, has laid the foundation for a new opportunity to reform lifelong learning (Chen and Liu, 2022; Gao et al., 2021). When integrated into the education process, AI can enhance the existing system and allow teachers to make the most of it to achieve the best results (Marwala, 2021; Chauncey and Mckenna, 2023).

Research Questions:

1. How does AI further personalization in learning?
2. How do adaptive learning environments influence learner outcomes?
3. How do intelligent tutors help learner engagement?
4. What ethical and data protection issues are associated with the use of AI in education?
5. In what way does the digital divide interfere with AI's lifelong learning acumen?

Research Aim and Objectives:

Aim: This research seeks to critically assess the possibilities of risk of incorporating AI in lifelong learning experiences and identify possibilities of AI in lifelong learning to inform the practices of educators and policymakers.

Objectives:
- To investigate the application of AI technologies for individualized educational content.
- To explore the effects of adaptive learning environments.
- To look at the position of intelligent tutors in engagement.
- To identify the ethical and privacy challenges of AI in education.
- To consider the impact of the digital divide on AI in lifelong learning.

Literature Review:

The Change in Lifelong Learning Over the Decades:

Education throughout our lifetime has transformed in the last few decades. Once a more general and non-strategic process becomes a systematic and step-by-step process using digital technology and AI (Shah, 2023). This evolution is attributed to the practical nature of skills, knowledge, and certification, which requires frequent updates due to the dynamic technological systems and labor market trends (Field, 2006). Currently, the term lifelong learning contains learning activities starting from formal education, non-formal education, and informal learning that are pursued for personal, professional, and mental enhancement of learners throughout life (Field, 2006).

Across the Globe: AI in Education Integrations:

AI in education is a topic of discussion and is increasing in popularity, and it is implemented in different capacities worldwide. Currently, the two leading nations practicing the application of AI for improved education output include the United States of America and China (Miao et al., 2021). Here, AI technologies are used as application and assessment tools and for monitoring students and facilities. This global phenomenon remains a clear indication of reforms in artificial intelligence to address educational dilemmas, such as disengagement and high dropout rates (Holmes et al., 2019).

Artificial Intelligence and Personalized Learning Paths:

Education can be revolutionized through the concept of Personalized learning, education and AI can help make the students feel engaged since their styles are different (Kaswan et al., 2024). AI-based algorithms provide insights into student data and modify the content to relate to students; this has been noted to boost students' engagement and performance (Bhutoria, 2022). For example, Pane et al. (2017) found that students in AI-enhanced learner-centered platforms beamed better on tests and had better retention rates than their counterparts who studied in conventional classes.Rouhiainen (2019) discussed in the Harvard Business Review case study the factors of AI and considered that with more development, AI can create new approaches to learning, which are as individual as abilities and

needs. Such systems of AI learning can help professors understand students' learning and capabilities in addition to how they progress in learning so that they can adopt a mutated teaching style. Thus, possible dropouts can be avoided because AI systems can intervene early to tackle a student's issues, such as finding students who require more assistance or those who require a challenge.

Adaptive Learning Environments and Their Efficacy:

An adaptive learning environment is an AI environment that makes the difficulty of learning material, and the pace of its delivery depend on the student's performance in the learning process immediately (Gilgorea et al., 2023). Every learner will be placed in properly distinguished learning activities and insights, and the right assistance will be provided to improve progression. Learning technologies facilitate real-time feedback and personalization of resources, meeting the need for improved learning (Baker, 2016). Using Yuanfudao and Zuoyebang as examples, Tang (2023) provides a case study on how the application of AI confronts problems in China's online education industry. These systems compile exam questions and have database-like repositories offering free web-based query and sample question services.

Role of Intelligent Tutors in Enhancing Learning Outcomes:

Intelligent tutoring systems (ITS) can enhance teaching productivity and learning achievement to a great extent by incorporating IT support for individualized directions and feedback, akin to one-on-one tutoring (Singh et al., 2022). Such systems have enhanced students' accountability, progression, and learning outcomes. According to Graesser et al. (2014), ITS has the potential to improve learning processes since it offers feedback in accordance with the learning style and abilities of the learner. Some real-life examples of ITS include Carnegie Learning and ALEKS. This expands educational content and provides the right responses on the spot. It significantly improves student achievement and attitude toward class (Koedinger et al., 2013).

Fundamental ethical issues and data protection obstacles in the use of AI in education:

The widespread use of AI in education already poses ethical and data protection risks. The first critical issue is the right to privacy, especially in relation to student data; for AI systems, access to vast amounts of data is critical to success (Mantelero, 2022). Personal data has to be protected, and thus, large amounts of data are needed by AI systems. According to Crawford and Calo (2016), there is only good AI, and ethical practice entails ensuring that data protection measures are stringent and that the agencies collect data and utilize it transparently. Initiatives like MyData. Harvard Business Review case by Rouhiainen (2019) discusses how students' data should be handled with respect and responsibly, such as in the case of MyData.org.

The lack of digital infrastructure as an implementation risk for AI integration:

However, the digital divide stands out as one of the most profound barriers that hinder the adoption of AI in education. An important challenge is the availability and use of the required technology and internet connections, especially in rural and more remote regions (Kitsara, 2022). This can only extend existing gaps in education and therefore requires that a gap of this nature be closed through solutions. According to Van Dijk (2017), these are the barriers of the digital divide; the ways to eliminate them are to invest in the provision of infrastructure, make the internet accessible, and sort digital skills and literacy initiatives. The inequality in the distribution of technology hardware will be solved, guaranteeing all students an equal chance at AI in education.The social and economic framework conditions must therefore be harmonised in order to drive innovation in the learning process without taking risks(Hamed, 2022).

Key Studies and Case Examples:

The Harvard Business Review case titled "How AI and Data Could Personalize Higher Education," published by Rouhiainen (2019), gives a broad overview of how AI can enhance the student experience. Learning systems using AI technologies can learn students' data and propose the most appropriate training programs in their case; as a result, students are more motivated to study, and the level of early dropouts is significantly lower. AI chatbots, as incorporated in the use case at the University of Murica, intensify student's engagement in different ways due to their ability to respond immediately to students' questions while simultaneously keeping them motivated.

Another case is given by Tang (2023), in which the author outlines the usage of AI in China's online education sector. Both the educational platforms that can be noted today, such as Yuanfudao or Zuoyebang, use AI to present various curricula, learning plans, and tutoring that correspond to the student's data. Such applications assist in the management of students' learning by anticipating deficiencies and proposing subsequent activities, which helps enhance outstanding academic performance. By applying the AI technique to their current practices, these firms enable students to achieve different learning experiences that fit their needs, enhancing performance.Further practical examples of the collection and use of educational data can be found in English-speaking countries (Sclater et al., 2016).
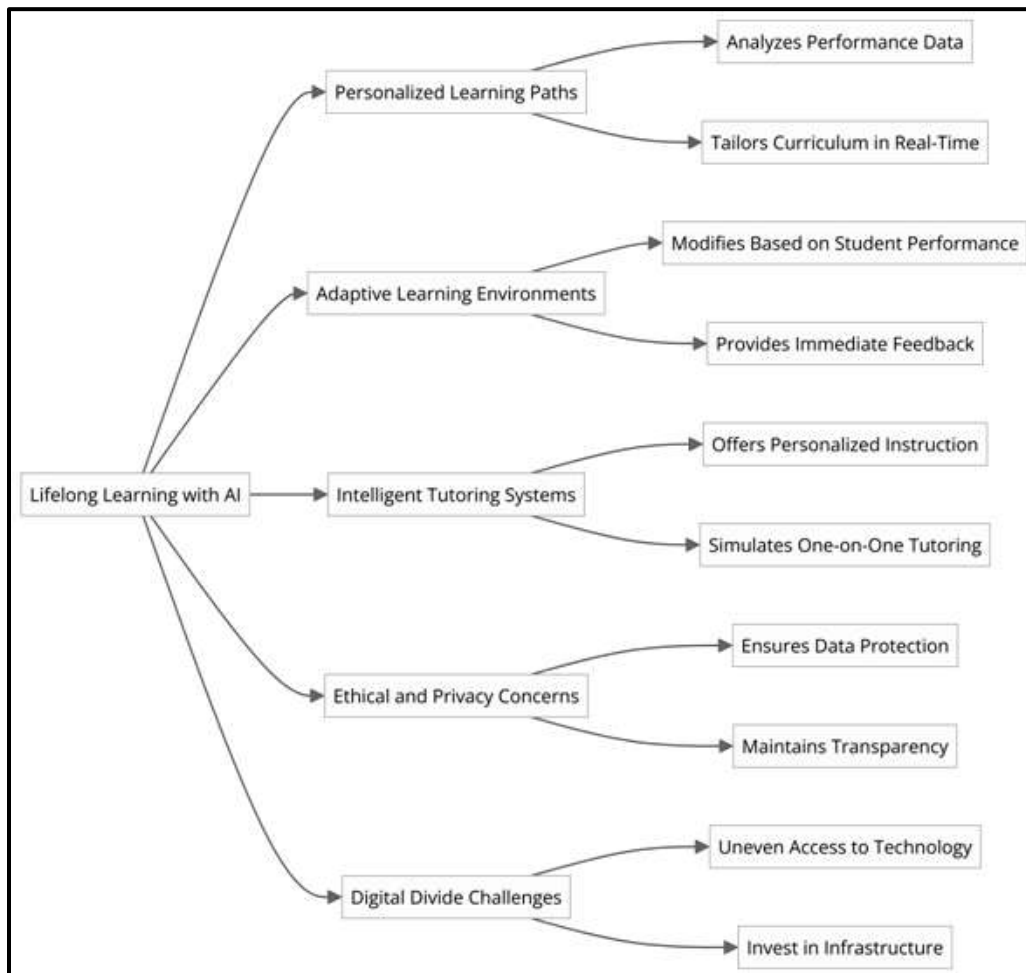
Theoretical Framework:

Figure 1: Theoretical Framework (Made by Author)

Lifelong learning is "education after the completion of compulsory formal education, continuing and sometimes lifelong, based on individual interest and choice." It contrasts conventional education based on the hope for a continuing learning process and differential sharpening of skills, which ideally should last a lifetime. As the job market and technologies advance, one can hardly stay put or demoted, rendering the perpetuity of learning as the basic necessity for job security in the modern era. Earlier, the informal form of lifelong learning, all the more, was not as planned and systematic as it is at present (Field, 2006). But it has, over the years, transformed from becoming one that is haphazard to a highly formalized process that is made possible by improvements in technology and training procedures. AI will change the way we teach with a view to lifelong learning.AI tools span from learners' personally assigned learning paths, adaptive learning environments, and even machines in between to intelligent tutor systems to improve and enable lifelong learning (Shah, 2023; Gilgorea et al., 2023).This approach is also being

pursued at education policy level in Germany. Increasing subsidies are intended to enable the practical use of AI in didactic design via adaptive tutoring systems (Witt et al., 2020).

AI-Driven Personalized Learning Paths:

The personalized learning approaches developed by applying artificial intelligence focus on every learner's learning goals and preferences in terms of educational content and activities (Kaswan et al., 2024). Performance data is collected, and so are the learning styles and progress; an AI curriculum modifies itself and classes in real time, thus providing ideal challenges and support for each student. This appears to increase participation and helps to boost the achievement of learning goals (Pane et al., 2017). Adaptive learning facilitated by theories in artificial intelligence involves constant assessment and optimization of the learning process. Research has also revealed that various adaptive learning methods enhance learners' performance by offering resources and assistance (Baker, 2016).

Intelligent Tutoring Systems:

An intelligent tutoring system (ITS) is an application of Artificial Intelligence that provides tutoring services that involve one-on-one instruction and assessment (Vujinović et al., 2024). These systems identify learning along with learning disorders, offer instructions to resolve these issues, and recognize different learning speeds and habits in addition to other abilities. It was also established that adopting such an approach leads to more students focusing during the lessons and better learning results (Graesser et al., 2014).

Relevant Theories and Models:

Lifelong learning has drawn from several educational theories about technological integration, giving an understanding of how AI technologies can be implemented.

Constructivist Learning Theory: in his Constructivist learning theory, Piaget posits that learning is the construction of new knowledge through the learner's interactional engagement. Knowledge acquisition is an intricate process that occurs within a social environment and entails constructing new knowledge on the already existing knowledge of the learners. The effectiveness of constructivist learning can also be complemented by artificial intelligence technologies in that they enhance real-world learning environments by providing activities, feedback, and learning that can be modified to cater to an individual learner's needs and abilities (Zajda and Zajda, 2021).

Self-Directed Learning Theory: Knowles stated that Self-directed learning theory explicates the responsibility of the learners as the key players in the learning process. This theory is promoted in an educated manner by incorporating AI technologies, as they offer tools and platforms that can help learners set their goals, track progress, and use relevant resources. Such independence enhances motivation and fosters a continuing education or learning culture throughout the lifecycle (Charokar and Dulloo, 2022).

Technology Adoption Model (TAM): As stated by Davis, the Technology Adoption Model (TAM) is the model that aims to explain how and why users incorporate IT into usage systems. According to TAM (Davis, 1989), there are two important predictors of performance: perceived ease of use and perceived usefulness (Abdullah et al., 2016). The rapid handling of data using AI in education supports the process of lifelong learning (Sorce and Issa, 2021).

Hypotheses:

H1: AI technologies enrich personalized lifelong learning experiences.

"This hypothesis rests on the principles of learning paths controlled by AI, which deliver educational content according to learners' needs. The Constructivist Learning Theory also supports this hypothesis, which focuses on personalized, interactive educational models."

H2: Adaptive learning environments supported by AI lead to improved learning outcomes.

"Adaptive learning environments are compatible with Constructivist and Self-Directed Learning theories as they offer students personalized guidance and feedback which encourages them and accelerates their learning processes."

H3: Intelligent tutoring systems increase learner engagement and satisfaction.

"Research shows that ITS improves learner participation and learning outcomes; this is supported by the Constructivist Learning Theory, which equates effective teaching with interactive and individualized teaching."

H4: Ethical and data protection concerns must be taken into account when implementing AI in education.

"This hypothesis concerns the ethical issues that Crawford and Calo (2016) described on how data protection must work and how companies must behave."

H5: The Digital Divide Impacts the Effectiveness of AI in Lifelong Learning

"The digital divide remains a critical problem, but other research indicates that interventions can help other students have a better chance of accessing the opportunities brought about by AI-enhanced learning."

Methodology:

Research Design and Strategy:

This study adopts a qualitative research approach when seeking to understand the role of AI in lifelong learning. The qualitative research approach within this study is intended to investigate the extent to which AI plays a relevant role in education and how it supports personalized learning, learning environments, and intelligent tutoring systems (Bell et al., 2022).

Research Strategy:

The research strategy for this study is qualitative, focusing on two primary methods: a literature review and a set of case studies. These methods are selected to create the most viable and diverse picture of the adaptation of AI technologies in lifelong learning. The first step is a literature review on lifelong learning, AI-assisted personal learning options and preferences, adaptive learning ecosystems, and intelligent tutors. This means that sources were obtained from databases of scientific journals, books, conference proceedings, and articles from reputable websites.

Data Collection Methods:

The literature search is the first data collection strategy and entails finding related literature in specified databases. This entails Source collection, which involves gathering scholarly articles, books, and reports on AI in education; Database search, which involves access to peer-reviewed publications from databases like Google Scholar; Search by rationale such as "AI in education," "personalized learning," "adaptive learning contexts," "intelligent tutoring systems" to ensure a broad search.

Inclusion and Exclusion Criteria:

Inclusion Criteria:

Research has been conducted in the last ten years, with samples of studies or case-based examples. The best sources of knowledge include peer-reviewed articles and high-quality reports from leading journals. Examples of cases to explain the use of AI in lifelong learning practices.

Exclusion Criteria:

Studies with incomplete data or inappropriate design. Publications older than ten years are not used unless they are seminal works essential to the theoretical foundation.

Methods of Data Analysis:

The data analysis process employs thematic analysis, which involves:

Initial Codes	Categories	Themes
Personalized learning content	Personalized Learning	AI Enhances Personalized Learning Experiences
Student engagement	Adaptive Learning Environments	Improved Learning Outcomes
Real-time feedback	Adaptive Learning Environments	
Tailored instruction	Intelligent Tutoring Systems	Increased Learner Engagement and Satisfaction
Customized feedback	Intelligent Tutoring Systems	
Data privacy concerns	Ethical and Privacy Considerations	Ethical and Privacy Challenges
Data security measures	Ethical and Privacy Considerations	

Initial Codes	Categories	Themes
Access to technology	Digital Divide	Impact of Digital Divide on AI Effectiveness
Internet connectivity issues	Digital Divide	

Table 1: Thematic Analysis Coding and Categorization(Made by Author)

Ensuring Reliability and Validity:

The reliability and validity of the results were ensured by the following steps:

To ensure the reliability of the information, source data collected from literature and cases was cross-checked. Presenting the analysis and interpretations to peers in the field and seeking their input, approval, critiques, etc. Following the processes of transparency of the whole research in terms of documenting all the processes and the decisions made during the data collection and analysis processes.

Results:

From the findings of this research and analysis of the literature review and case studies of the integration of AI in lifelong learning, the following important findings have been deduced, and important themes have been identified. These themes include individualized instruction and learning, intelligent learning environments, computer-based tutors, ethical considerations and privacy use, and the digital divide issue. AI is applied in custom learning application software where educational content is delivered to suit an individual need. Various types of research prove the effectiveness of AI as a tool that can personalize learning processes based on students' data, thus increasing learners' motivation and performance rates (Pane et al., 2017; Rouhiainen, 2019). Research has shown that environments that adapt according to the learner's performance are helpful and can greatly impact learning effectiveness. Such environments facilitate a faster and more efficient manner of learning due to immediate and accurate feedback, besides offering customized learning resources depending on learning requirements (Baker, 2016).In the case of ITS, it has been seen that this education model has had a very positive impact on learner engagement and satisfaction. Such systems provide mass instruction and guidance, which is more effective than face-to-face mentored training in increasing students' achievement and encouraging them in contrast to other tutoring (Graesser et al., 2014; Koedinger et al., 2013).The adoption of AI in education has several ethical and privacy concerns that must be addressed(Balakrishnan et al., 2024). Data privacy and ethical use of artificial intelligence are must-succeed policies for preserving and creating trust and equality. To protect these values, strong data protection measures and, at the least, clarity on the utilization of the data must be put into practice (Crawford and Calo, 2016; Rouhiainen, 2019). This is a major issue regarding the use of AI in lifelong learning, and as a result, widespread success cannot be easily obtained. Equity in key resources, such as access to necessary technologies and internet connection, is also partially available, especially in developing regions and the third world, worsening educational inequity (Van Dijk, 2017). With advanced technology, various digital learning solutions have demonstrated ways of enhancing lifelong learning. Current useful applications of AI can be seen among firms like Yuanfudao and Zuoyebang from China, which provide individualistic tutoring and learning schedules. These platforms accumulate large amounts of student performance data, giving learning directions and performance summary reports (Kuo & Yang, 2017). Likewise, at the University of Murcia, the AI chatbot enhanced the students' engagement simply because they got prompt answers to their questions, which motivated them to contribute more to the class (Rouhiainen, 2019). The effectiveness of incorporating the AI helmet in the learning platforms has been highly rated based on the learner's outcomes and engagement levels. Flexible learning structures necessary for tailored learning resulting from the adoption of competency-based teaching and learning have been seen to enhance students' performance on standardized assessments as well as raise graduation rates (Pane et al., 2017).

Hypothesis Testing:

H1: AI technologies enhance personalized learning experiences in lifelong learning.

> **Accepted:** The evidence from literature and case studies supports this hypothesis with a considerable amount of evidence. Existing research demonstrates that AI technologies can generate niched plans that enhance student's learning performance and involvement (Pane et al., 2017; Rouhiainen, 2019).

H2: Adaptive learning environments supported by AI lead to improved learning outcomes.

Accepted: The findings indicate that any adaptable learning environment increases the level of achievement by delivering immediate results and asking for further resources (Baker, 2016).

H3: Intelligent tutoring systems increase learner engagement and satisfaction.

Accepted: Case studies and literature indicate that ITS increases the learners' satisfaction level and participation level by providing them with customized learning material and feedback (Koedinger et al., 2013; Graesser et al., 2014).

H4: AI integration in education faces significant ethical and privacy challenges.

Accepted: Some of the key issues arising from using artificial intelligence in education based on the research include the following: The use of AI in education, therefore, indeed has ethical and privacy problems. Privacy and risks of using AI ethically are immensely important (Crawford & Calo, 2016; Rouhiainen, 2019).

H5: The digital divide impacts the effectiveness of AI in lifelong learning.

Partially Rejected: Although the digital divide is a major concern, other studies have identified that if there are remedies for the digital divide, like infrastructure projects for AI learning and digital literacy programs for teaching, there will be a resultant expanded accessibility to AI learning (Van Dijk, 2017).

Case Examples:

In the context of Tang (2023), the mentioned platforms use AI, and personal tutoring/learning plans are given. Through the data they collect and analyze on the students' performance, they can create ideal learning paths and performance analysis reports for the students, hence enhancing the students' performance. Rouhiainen (2019) has stated that the case of the University of Murcia makes it evident that the application of AI-based chatbots has augmented students' interest and their learning process by responding to queries in real time. Both case examples show that AI technologies can be more practical when applying lifelong learning (Edam, 2024).

Discussion:

Interpretation of Results:

As the findings of this work demonstrate, the analyzed AI technologies offer key insights into the role of lifelong learning. Essentially, the findings support most of the posited hypotheses regarding the beneficial impact of AI in delivering personalized learning experiences and in enhancing teaching-learning environments typified by adaptivity and intelligent tutoring systems. However, the hypothesis concerning the digital divide is rather ambiguous and could be considered inconclusive.

Theoretical Implications for Lifelong Learning and AI Integration:

The application of AI to lifelong learning can be well related to several foundational theories in education. For example, one theory prefers a deeper and more individualized learning process implying interaction with an AI system – the Constructivist Learning Theory. AI allows for engagement in learning activities based on students' needs and learning styles while incorporating the constructivism theory proposed by Piaget (1976). Similarly, Self-Directed Learning Theory, which requires that the learner take the initiative to plan, assess, and acquire resources that s/he finds useful, is supported by AI tools (Knowles, 1975). In particular, the Technology Acceptance Model (TAM) offers insights into adopting AI technologies within education. This shows that perceived usefulness and ease of use are central to utilizing AI tools. Observing the further development of technologies as user-friendly for AI technologies in education and the demonstration of added value, we will see a further increase in the use of AI (Davis, 1989).

Implications for Practice:

Leverage AI technologies to develop customized or individualized learning activities. Students have personal data that can be analyzed to figure out how AI can better teach them and improve retention of material. There is a recommendation that institutions should incorporate some learning platforms, such as Yuanfudao and Zuoyebang, as AI-driven platforms in offering teaching-learning facilities and learning pathways (Tang, 2023). There is also a need to incorporate the principles of adaptive learning in the curriculum, which involve learning environments that

change as a student progresses. These environments support workplace learning and help learners engage with tasks effectively, leading to better learning results (Baker, 2016). Learner satisfaction and participation should also increase as ITS provides a tailored approach to teaching and assessment. Institutions should implement ITS based on one-on-one tutoring, which has been seen to enhance performance to an extent (Graesser et al., 2014).Progress will not only be driven by technology, but also by the type of didactics that society can utilise (Witt et al., 2020).

Potential Challenges and Solutions:

Privacy is a critical factor, and ethical issues must also be well-handled. Regarding this, Crawford and Calo (2016) suggested that institutions should ensure proper policies and protection of students' data, as well as policies on using AI technologies to deal with students' information. Adopting frameworks like MyData. It is stated that, through collaboration with org, an important positive impact can be ensured regarding the ethical use of AI (Rouhiainen, 2019). As a result, technology limitation deepens a digital divide issue, escalating a significant barrier to applying AI in education. Thus, institutions must invest in infrastructure and guarantee that the Internet Connection is readily available, especially to the most vulnerable populations. Besides, the focus should be on increasing support for the Digital Divide through sponsoring programs such as digital literacy programs (Van Dijk, 2017).

Study Limitations:

Further research should be done with a pool of similar and different cases to obtain a wider understanding of the subjects under study. The author also states that the case studies and findings are mainly based on developed countries such as the United States and China. This might make overlooking certain issues or achievements easier in other geographical locations. It would offer a broader perspective if the research considered different geographical locations.

Suggestions for Addressing These Limitations in Future Research:

Future research should include more case studies from different educational contexts and regions. This will help capture a wider range of AI applications and their impact on lifelong learning.

Conclusions and Recommendations:

AI applications are most relevant to lifelong learning in as much as they offer potentially transformative ways to develop or deploy personalized and adaptive learning environments and intelligent tutoring systems (Aleven et al., 2016). AI technologies have been shown to enhance the personalization of educational materials in response to learner preferences and behavior to increase student engagement and performance levels (Pane et al., 2017; Rouhiainen, 2019). Teaching assisted by technologies based on artificial intelligence involves immediate feedback and tailored support adapted to the needs of a learner, which makes the teaching-learning process more effective, according to Baker (2016). One of the most significant advantages of using an intelligent tutoring system is that it delivers tailored content and feedback that enhances learners' engagement (Graesser et al., 2014; Koedinger et al., 2013). The applications of AI in education bring about considerable ethical issues in how personal information is collected, used, and protected (Crawford and Calo, 2016; Rouhiainen, 2019). Despite the many opportunities identified when it comes to lifelong learning, an issue that has been observed and still prevails as a reason why AI cannot be well implemented is the issue of the digital divide. However, targeted interventions can offset its impact, thus ensuring equal opportunities to embrace Artificial Intelligence modulated learning (Van Dijk, 2017).

Recommendations for Practice and Policy:

The application of artificial intelligence in learning management can be used by teachers to create appropriate curricula based on student data. Such implementations are the perfect learning platforms, and some of the best platforms are Yuanfudao and Zuoyebang (Tang, 2023). The recommendations of adaptive learning environments can help continually modify and customize the educational content being taught to learners. These technologies give instantaneous responses and foster learning (Baker, 2016). Features such as feedback and advice can imitate the concept of over one person's head instructions. In general, ITS should be adopted in institutions to optimize students' performance and satisfaction (Graesser et al., 2014).

Policy Recommendations for Supporting AI Integration:

AI development should be recognized as having potential legal implications. Thus, governments and other educational bodies should set certain ethical standards and laws regarding using artificial intelligence in education. This includes compliance with data protection and ethical requirements regarding the implementation of AI in education (Crawford & Calo, 2016). In order to overcome the digital divide, more resources should be allocated to fund digital infrastructure investments, especially in less developed areas. Poor students and those from low-income families cannot afford the necessary technologies and internet service to ensure they are not left behind in AI-enhanced learning (Van Dijk, 2017). Implementing digital literacy programs can help learners and educators effectively use AI technologies.

Future Research Directions:

In the context of this study, another research gap that has emerged is the long-term impact of AI in education on lifelong learning in terms of learning outcomes.

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